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EXAMINER	
FOTAKIS, ARISTOCRATIS	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 10/799,543	Applicant(s) HAN ET AL.	
	Examiner Aristocratis Fotakis	Art Unit 2611	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *09/22/2007*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1 - 26* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1 -26* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to

consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 1 – 13, 15 – 21, 23 – 24 and 26 are rejected under 35 U.S.C. 103(a) as being unpatentable over McEwen et al (US 6,732,328) in view of Akiyama et al (US 7,080,313) and further in view of Abu-Rgheff et al. ("A Modified Viterbi Decoder based upon Cross Correlation for use in Bandwidth Efficient Systems", Digital Satellite Communications, 1995., Tenth International Conference, 15-19 May 1995, University of Plymouth, U.K).

Re claims 1, 7 and 17, McEwen teaches of a method and a machine-readable medium (Col 1, Lines 20 – 34, Fig.10) embodying information indicative of instructions for causing one or more machines to perform operations comprising: obtaining an output signal sequence (Y_K, Col 10, Lines 35 - 45) from a partial response channel (#17, Fig.2); determining an input sequence (Col 10, Line 55 - 57) of the partial response channel (#17, Fig.2) by maximizing a correlation metric (path metric corresponding to the maximum likelihood, V_{DATA}) from the obtained output sequence (Y_K, output from the partial channel response), and providing an output corresponding to the determined input sequence (Col 10, Lines 58 – 67, Fig.2). However, McEwen does not specifically show the correlation performed in the branch metric unit and specifically maximizing a cross-correlation.

Akiyama teaches of a signal evaluation apparatus and signal evaluation method for evaluating a reproduction signal of a recording medium (Col 1, Lines 6 – 8). Akiyama teaches of a branch metric $(Z_K - Y_K)^2$ of each branch metrics (correlation) where Z_K is the obtained output sequences and Y_K is the estimated output sequences (Col 2, Lines 8 – 20) for a partial response channel (PRML, Col 1, Line 26 and Col 7, Lines 10 – 21); the estimated output sequence being estimated based on the partial response channel (Col 8, Lines 63 – 67).

Abu-Rgheff teaches of the decision rule used by the classic viterbi algorithm is to decide on a transmitted symbol m_i in favour of the one that gives maximum log likelihood function taken as metric. This is equivalent to the requirement that:

$$\sum_j (x_j - s_{ij})^2$$

is a minimum, when x_j represents sample of received symbol and s_{ij} corresponds to sample of transmitted symbol. Now $\sum s_{ij}^2$ stands for the transmitted energy per symbol and $^2\sum x_j$ is independent of transmitted symbol, thus in order to maximize the metric we need to maximize the term $\sum_j x_j s_{ij}$. In the modified algorithm, the correlation between x_j and s_{ij} must be maximum. Therefore the metric computed using Viterbi rule is the same as that computed using the modified rule and as a result both decoders will have the same BER when transmission is influenced by Gaussian noise (Page 3).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have known that a branch metric unit would correlate the obtained output sequence with the estimated output sequence so that the survivor path memory would output the maximum likelihood sequence estimate V_{DATA}.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have maximized the correlation metric by maximizing the cross-correlation term.

Re claim 13, McEwen teaches of an apparatus comprising: a branch metric generator (#53, BMU, Fig.4) that generates branch metrics comprising a correlation for a partial response channel (#17, Fig.2); an add-compare-select component (#55, ACS, Fig.4) that compares paths (#56, Fig.4) and determines survivor paths (#57, Fig.4) using generated branch metrics; a memory that retains metrics information (path memory, Col 2, Lines 3 - 4); and a trace-back component that determines a best path of the survivor paths and outputs sequence information based on the determined best path (Col 2, Lines 4 – 10). However, McEwen does not specifically show the correlation performed in the branch metric unit and specifically maximizing a cross-correlation.

Akiyama teaches of a signal evaluation apparatus and signal evaluation method for evaluating a reproduction signal of a recording medium (Col 1, Lines 6 – 8). Akiyama teaches of a branch metric $(Z_K - Y_K)^2$ of each branch metrics (correlation) where Z_K is the obtained output sequences and Y_K is the estimated output sequences (Col 2, Lines

8 – 20) for a partial response channel (PRML, Col 1, Line 26 and Col 7, Lines 10 – 21); the estimated output sequence being estimated based on the partial response channel (Col 8, Lines 63 – 67);

Abu-Rgheff teaches of the decision rule used by the classic viterbi algorithm is to decide on a transmitted symbol m_i in favour of the one that gives maximum log likelihood function taken as metric. This is equivalent to the requirement that:

$$\sum_j (x_j - s_{ij})^2$$

is a minimum, when x_j represents sample of received symbol and s_{ij} corresponds to sample of transmitted symbol. Now $\sum s_{ij}^2$ stands for the transmitted energy per symbol and $^2\sum x_j$ is independent of transmitted symbol, thus in order to maximize the metric we need to maximize the term $\sum_j x_j s_{ij}$. In the modified algorithm, the correlation between x_j and s_{ij} must be maximum. Therefore the metric computed using Viterbi rule is the same as that computed using the modified rule and as a result both decoders will have the same BER when transmission is influenced by Gaussian noise (Page 3).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have known that a branch metric unit would correlate the obtained output sequence with the estimated output sequence so that the survivor path memory would output the maximum likelihood sequence estimate V_{DATA}.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have maximized the correlation metric by maximizing the cross-correlation term.

Re claims 2, 8 and 18, McEwen teaches of employing Viterbi detection (#50, Fig.2) using a cross-correlation branch metric (#53, Fig.4) (Col 10, Lines 62 – 65).

Re claims 3, 9, 15 and 19, McEwen teaches of the partial response channel (#17, Fig.2) having a transfer function (*H(D)*, Col 7, Lines 8 - 12) defined according to a target polynomial, $T(D)=p_0 +p_1D+\ldots+P_M D^M$ (Col 7, Lines 8 - 12) the Viterbi detection operates according to a trellis having 2^M states ($2^L - 1$ states, Col 7, lines 47 – 60), and all survivor paths (associated with all the 2^M states in the trellis merge in *M* steps (Col 2, lines 3 – 4).

Re claims 4, 10 and 20, McEwen teaches of providing the output corresponding to the determined input sequence (from #50, Fig.2) comprises providing the determined input sequence to an additional sequence-processing component (#60, Fig.2) (Col 7, Lines 61 – 67 to Col 8, Lines 1 – 10).

Re claims 5 and 11, McEwen teaches of the output signal sequence (Y_K) comprising a convolution of the input sequence (Col 10, Line 55 - 57) and a target

polynomial (*IDEAL*$_K$, Col 10, Line 47) of the partial response channel (Col 10, Lines 46 – 57).

Re claims 6 and 12, McEwen teaches of the partial response channel comprising a data storage medium (Col 1, Lines 20 – 34, Fig.10), and said obtaining the output signal sequence comprises sampling a signal generated from the data storage medium (Fig.10, sampler #212, Col 15, lines 19 – 46).

Re claim 16, McEwen teaches of the memory comprising a path memory of length M (L, Col 3, Lines 13 – 15).

Re claims 21 and 24, McEwen teaches of a data storage system (Col 1, Lines 20 – 34, Fig.10) comprising: an input line that provides a sampled channel sequence (Y_K, Col 10, Lines 35 - 45) (Fig.2); Veterbi detection means for determining a recovered sequence (Col 10, Line 55 - 57) from the sampled channel sequence (Y_K, Col 10, Lines 35 - 45), the Viterbi detection means including means for maximizing correlation (path metric corresponding to the maximum likelihood, V_{DATA}), minimizing a probability of making an error in determining the recovered sequence (Col 2, Lines 29 – 39). However, McEwen does not specifically show the correlation performed in the branch metric unit and specifically maximizing a cross-correlation.

Akiyama teaches of a signal evaluation apparatus and signal evaluation method for evaluating a reproduction signal of a recording medium (Col 1, Lines 6 – 8). Akiyama teaches of a branch metric $(Z_K - Y_K)^2$ of each branch metrics (correlation) where Z_K is the obtained output sequences and Y_K is the estimated output sequences (Col 2, Lines 8 – 20) for a partial response channel (PRML, Col 1, Line 26 and Col 7, Lines 10 – 21); the estimated output sequence being estimated based on the partial response channel (Col 8, Lines 63 – 67).

Abu-Rgheff teaches of the decision rule used by the classic viterbi algorithm is to decide on a transmitted symbol m_i in favour of the one that gives maximum log likelihood function taken as metric. This is equivalent to the requirement that:

$$\sum_j (x_j - s_{ij})^2$$

is a minimum, when x_j represents sample of received symbol and s_{ij} corresponds to sample of transmitted symbol. Now $\sum s_{ij}^2$ stands for the transmitted energy per symbol and $^2\sum x_j$ is independent of transmitted symbol, thus in order to maximize the metric we need to maximize the term $\sum_j x_j s_{ij}$. In the modified algorithm, the correlation between x_j and s_{ij} must be maximum. Therefore the metric computed using Viterbi rule is the same as that computed using the modified rule and as a result both decoders will have the same BER when transmission is influenced by Gaussian noise (Page 3).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have known that a branch metric unit would correlate the obtained output sequence with the estimated output sequence so that the survivor path memory would output the maximum likelihood sequence estimate V_{DATA}.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have maximized the correlation metric by maximizing the cross-correlation term.

Re claims 23 and 26, McEwen teaches of a head-disk assembly (#200, Fig.10, Col comprising the input line (Col 15, Lines 48 – 57).

Claim 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over McEwen, Akiyama and Abu-Rgheff as applied to claim 13 above, and further in view of Cideciyan et al (US 6,377,635).

McEwen, Akiyama and Abu-Rgheff teach all the limitations of claim 13. However, they do not specifically show the equation for determining survivor paths.

Cideciyan teaches of methods and apparatus are provided for implementing high-speed and area efficient architectures for Viterbi detection of generalized partial response signals using both partial matched filter and matched filter metrics (Abstract, lines 1 – 4). Cideciyan also teaches of the polynomial of claim 15 (Col 4, lines 11 – 12) as well as the correlation discussed in claim 13 (Col 4, Lines 15 – 20, equation 2) of the

obtained output sequences (y_n) and estimated output sequences (sequence $\{\hat{a}_n\}$). The add-compare-select component (ACS unit, Col 3, Lines 44 – 55) compares paths and determines survivor paths by maximizing a quantity defined according to an equation (equation 3, first term), $\sum_{k=0}^{N} y_k \cdot y_k^*$, y_k corresponds to a real channel output, and y_k^* corresponds to an estimated channel output (Col 4, Lines 20 – 44).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have used the equation above to minimize the metric for simplifying the architecture/implementation of the Viterbi detector.

Claims 22 and 25 are rejected under 35 U.S.C. 103(a) as being unpatentable over McEwen, Akiyama and Abu-Rgheff as applied to claims 21 and 24 above, and further in view of Fisher et al (US 6,249,398).

McEwen, Akiyama and Abu-Rgheff teach all the limitations of claims 21 and 24. McEwen also teaches of gain amplification (change in the amplitude, #208, Col 15, Lines 36 – 40). Akiyama also teaches of an RF circuit for adjusting the amplitude (Col 7, Lines 22 – 25). However, McEwen, Akiyama and Abu-Rgheff do not specifically teach of providing robust tolerance of phase uncertainty with the widely varying amplitude waveform.

Fisher teaches of a new class of fixed partial response targets for use in a PRML magnetic medium read channel (Abstract, Lines 1 – 2). To properly equalize and detect the user-data bits, several parameters must be adaptively controlled. The sample

values at node 54 are applied to an error generator circuit (#64, Fig.2) where they are compared to the ideal target response values. These values are in accordance with a $7+4D-4D^2-5D^3-2D^4$ polynomial. These values are relative and they may be scaled to the A/D output bits as appropriate. The error generator (#64) provides an error signal via (#66) to gain control circuitry (varying amplitude, #68, Fig.2), which in turn controls the variable gain filter (#42). The error generator 64 also provides input via path 67 to timing control circuitry (#70), which in turn adjusts the sampling phase of the sampler (#46) (Fig.2, Col 6, Lines 20 – 43).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have provided a time control circuitry in order to control any phase changes for improving signal acquisition performance in a disk drive read channel.

Response to Arguments

Applicant's arguments filed September 17, 2007 have been fully considered but they are not persuasive.

Re the independent claims, Applicants have amended the amendments to recite that the cross-correlation is maximized to distinguish over the cross-correlation metric of the traditional Viterbi detector approach. However, the IEEE publication of Abu-Rgheff show that in a Viterbi algorithm the squared Euclidean distance is minimum when considering the correlation metric. The metric has three terms but only the cross-correlation term is considered. Maximizing the cross-correlation term can maximize the metric.

Re claim 16, Applicants have submitted that McEwen does not specify the length of the path memory. Examiner submits that this is taught in the background of McEwen Patent for a conventional Viterbi algorithm (Col 2, Lines 1 – 10 and Col 3, Lines 13 – 24).

Re claim 14, Applicants have submitted that Cideciyan does appear to show the cross- correlation term in the equations and fails to teach or suggest an add-compare-select component that compares paths and determines survivor paths using generated branch metrics comprising a cross-correlation of obtained output sequences and

estimated output sequences for a partial response channel, as claimed. Examiner submits that Cideciyan shows the cross-correlation term in the first term of equation 3 (Col 4, Equation 3). Cideciyan teaches of an add-compare-select component that compares paths and determines survivor paths using generated branch metrics comprising a cross-correlation of obtained output sequences and estimated output sequences for a partial response channel (Col 3, Lines 44 – 67).

Re claims 22 and 25, Applicants have submitted that Fisher says nothing about a waveform of widely varying amplitude. Examiner submits that Fisher discloses of a gain control (#68, Fig.2) that controls the read signal that has variable gain in a variable gain filter.

Conclusion

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of

the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Aristocratis Fotakis whose telephone number is (571) 270-1206. The examiner can normally be reached on Monday - Thursday 7 - 5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Chieh Fan can be reached on (571) 272-3042. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

AF

CHIEH M. FAN
SUPERVISORY PATENT EXAMINER